REMARKS

Review and reconsideration on the merits are requested.

Applicants follow the paragraphing of the Examiner.

Paragraph 1

Applicants appreciate the preliminary amendments being entered.

Paragraph 2

The specification has been checked and minor errors noted corrected.

Paragraph 3

The Examiner points out that the specification contains terms which are not clear, concise and exact and requests that the specification be revised carefully to comply with 35 U.S.C. § 112, first paragraph. In addition to the terms the Examiner mentions at page 2, lines 19-22 and line 26 and page 5, lines 7-10, other minor errors noted in the specification will be corrected. In a telephone interview on March 18, 2002, the Examiner indicated a substitute specification seemed appropriate. The same will shortly be filed.

Paragraph 4

Claims 1-6 are objected to because of various formalities.

Each of the formalities noted by the Examiner has been corrected.

Withdrawal of the objection is requested.

Paragraph 5

Formal.

Paragraph 6

Claims 1-7 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite, the Examiner specifically characterizing "semi-hard" as indefinite. Applicants adopt the Examiner's suggestion and delete "semi-hard" from the claims.

With respect to claim 3 failing to indicate when the further heat treatment is to be performed, claim 3 is amended in a manner which clarifies this point. If the Examiner believes further limitation is necessary, the Examiner is requested to contact the undersigned.

The amendment to claim 1 on the above points does not narrow claim 1. The amendment to claim 3 clarifies claim 3, but when construed in light of the specification does not narrow claim 3.

Paragraph 7

Formal.

Prior art considered: JP Patent No. 58-181823 Endo (Endo); U.S. Patent No. 5,156,923 Jha et al (Jha); "Applicants' admissions"; U.S. Patent No. 5,716,460 Manning et al (Manning).

Paragraph 8

Claims 1, 6 and 7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Endo in view of either Jha or Applicants' admissions.

Paragraph 9

Claims 2-5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Endo in view of either Jha or Applicants' admissions and further in view of Manning.

The above rejections are respectfully traversed.

The Examiner's reading of the prior art as set forth in the Action and the Examiner's application of the prior art as set forth in the Action and will not be repeated here except as appropriate to an understanding of Applicants' traversal.

Since the Examiner has treated Jha and Applicants' admissions as essentially the same (Action, page 5, second full paragraph), Applicants rely upon their traversal regarding Jha to apply with equal force to Applicants' admissions.

With respect to the Examiner's remarks regarding claim 5 on page 7 of the Action, the Examiner's interpretation is correct.

Applicants now present their traversal.

The Present Invention

The present invention relates to a method of producing a magnetic material wherein coercivity can be easily regulated and improved clearness of the on-off state of a magnetized state and a demagnetized state can be achieved.

The method comprises certain steps, as now explained.

One prepares a multi-layered body in which layers "A" and layers "B" are prepared. Each of layers "A" contains as the main component thereof Fe which has magnetic properties. Each of layers "B" each contains a non-magnetic Cu group metal as the main component thereof. Layers "A" and layers "B" are stacked on each other to prepare the multi-layer body. Thereafter the multi-layer body is heated so that each of layers "B" is partially divided by a dividing heat treatment. Then, cold plastic working is applied to the multi-layer body thus treated so that the

magnetic material will provide the desired ease of coercivity regulation and improved clearness of on-off between a magnetized state and a demagnetized state.

Claim 6 describes the magnetic material as having a structure in which layers "A" each containing as the main component thereof magnetic Fe and layers "B" each containing the non-magnetic Cu group metal as the main component are stacked on each other, each of layers "B" being provided with the shape of a sheet partially divided, that is, in the form of a partially divided layer.

Perhaps the most important feature of the present invention is the <u>dividing heat treatment or heating</u> of the stacked or layered material (multi-layer body) to thereby achieve partial dividing of the layers "B". This step is clearly recited in claim 1 (amended).

In accordance with the present invention, the material most suitable for layer "A" is a metal which consists essentially of Fe, because the degree of mutual solid solubility of Fe and Cu is only a few percent. As a consequence, the Fe and Cu phases can be present as separate phases even when they are heated. Newly added claims define Fe as the material which is most appropriate as layer "A". Support occurs at page 7, lines 17-23 of the specification.

<u>Details of the Present Invention</u>

In accordance with the present invention, layers "A" provide the principle magnetic properties to the magnetic material of the present invention, while layers "B" are present as a second phase to prevent magnetic walls from moving and to prevent magnetic domains from being rotated. As a consequence, layers "B" act to enhance coercivity.

In accordance with the present invention, sheets of two different kinds of materials (basically copper and iron) are alternately stacked, which makes it possible to prevent intermixing of the components from occurring as would happen, for example, in an ingot in the case of conventional melting when Cu and Fe are melted.

In accordance with the present invention, the stacked multi-layered material is then heated so that each of the non-magnetic layers of the Cu group metal will be thermally divided. The thermally divided layers of the Cu group metal yield a second phase which acts to prevent the movement of magnetic walls and to prevent magnetic domains from rotating. After the heating (dividing heat treatment), the material is cold plastic worked or rolled so that the desired magnetic anisotropy results in the final structure, with the result that it is possible to enhance each of coercivity, squareness ratio and magnetization steepness.

By such cold working, the ultimate composite magnetic material will have the textures or phases of {100} <110> and {112} <110>. These textures or phases will act to restrict the factors which suppress movement of magnetic walls and rotation of magnetic domains, so that movement of magnetic walls and rotation of magnetic domains will occur at a time when a certain magnetic field is applied thereto; as a consequence, there is an enhancement in the squareness ratio and the magnetization steepness.

Because of the cold plastic working described above, which occurs after layers "B" are partially divided by the dividing heat treatment, it is possible to obtain the structure recited in claim 6 of the present application in which partially divided layers of the Cu-group metal are present.

The present invention thus provides an optimal method and an optimal structure for obtaining the desired magnetic properties of the present invention, namely an improved squareness ratio and improved magnetization steepness.

Jha

As above discussed, the dividing heat treatment of the present invention is an important feature of the present invention. Such a dividing heat treatment is clearly entirely different from the process of Jha wherein Invar layers are mechanically "torn off" by rolling.

In fact, none of the prior art relied upon by the Examiner discloses the concept of the dividing heat treatment of the present invention, that is, dividing which is achieved by using heating of particular layers provided in a layered structure. In fact, only Jha discloses a layered structure. However, in Jha, the only relevant disclosure relates to the combination of Cu and Invar (a Fe-Ni based alloy). This is an important point since, in general, Invar and Cu dissolve in each other to form a solid solution upon heating, whereby, upon heating, an alloy is formed. This is quite logical and desirable in Jha, since Jha relates to a substrate for electronic circuits in which Invar and Cu are individually present to achieve the desired compatibility of high thermal conduction and low thermal expansion. However, this disclosure in Jha would not suggest to one of ordinary skill in the art heating a layered structure of Invar and Cu since heating of such a layered structure would result in an alloy structure, which would quite clearly make it impossible to achieve the desired objects of Jha.

Quite in distinction to the present invention, Jha discloses a method of producing a composite material having controlled thermal expansion. The Jha composite material is used as

an electronic circuit substrate. Jha is based upon two characteristics, one of which is low thermal expansion, namely, a degree of thermal expansion approaching that of the electronic circuit which has very low thermal expansion. A second is the characteristic of thermal conduction in each of the three-dimensional directions. In order to achieve these characteristics, in accordance with the teaching of Jha a first metal from Cu, Al or Ag is used. This first metal shows excellent thermal conductivity. The second metal used in Jha is Invar or molybdenum. The second metal shows superior low thermal expansion. These two different types of materials are used in Jha since Jha desires to obtain a material exhibiting both good low thermal expansion and good thermal conductivity.

It is easily seen that the magnetic material of the present invention is quite distinct from the magnetic material of Jha. This is emphasized in the Embodiments (page 16, et seq) of the present specification where the combination of magnetic iron and oxygen-free copper as optimal embodiments are used. Both of these materials have high thermal expansion, quite contrary to the combination of materials of Jha.

Distinctions Between the Present Claims and Jha

Perhaps the most important distinction between the present invention and Jha is as follows. In Jha, rolling is used to perform metallurgical bonding between the first metal and the second metal. With respect to the Jha rolling, Jha discloses that "in the case of Cu Invar, the reduction of the thickness is performed by the cold-rolling" and that "it is performed without such diffusion as to lower the thermal conductivity", and that "if necessary, the composite material is subjected to a heat treatment so that the bonding of the layers of the composite

material and the treatability may be improved, which heat treatment is selected and controlled to avoid the occurrence of such diffusion as to lower the thermal conductivity thereof".

Thus, in Jha, it is quite clear that a major object is to minimize a deterioration of Invar characteristics, which is caused by diffusion of the Cu and Ni contained in the Invar, and to minimize deterioration of the thermal conductivity of Cu, which would result from such diffusion. Phrased differently, in Jha, heating of the composite material causes a diffusion phase (an alloy phase) which results from the diffusion of the Invar alloy and Cu. The result is that the combined effects of low thermal expansion and good thermal conductivity are lowered.

Further Distinctions Over Jha

In accordance with the present invention, heating has been selected as the means to perform the dividing (dividing heat treatment) of the layers "B" containing as the main component the Cu group metal. The dividing heat treatment for the layers in accordance with the present invention is entirely different from any procedure in Jha. Specifically, in accordance with the present invention, heating is required to perform dividing of the layers "B", and the heating is preferably in the range of from 685 to 1,085°C. To emphasize the difference between the present invention and Jha, if the composite material of Jha were to be heated to a temperature within this range (685 to 1,085°C), diffusion would occur (a diffusion phase would result), resulting in an alloy phase which would be contrary to the desired objects in Jha of achieving the simultaneous effects of low thermal expansion and good thermal conductivity. Thus, quite clearly, no motivation exists to modify in any fashion from the teaching in Jha.

Thus, Applicants must disagree with the Examiner's interpretation of Jha as set forth in the Action at page 5, second full paragraph.

The present invention is also quite distinct from Jha with respect to metal structure. In Jha, a metal structure is provided so that "the Invar material is broken up in the matrix of Cu by the rolling thereof" so that "the Invar material is distributed in the matrix of the copper phase extending in the continuous state along three mutually perpendicular axes". See the claims of Jha. Thus, in Jha, the Cu phase is required to be continuously extended in three dimensions so that good heat dissipation will result when the composite material of Jha is used as a circuit board substrate.

In distinction to this mandatory concept in Jha, in accordance with the present invention, there is provided a magnetic material where a partially divided non-magnetic Cu group metal is layered in a matrix of magnetic Fe. This is clearly shown in Figs. 4A to 4C and Figs. 5A to 5C of the present application.

The present invention thus relates to an optimal metal structure of a magnetic material which is capable of having either a magnetized or demagnetized state, in which an optimal structure for suppressing the movement of magnetic walls in a matrix containing as the main component thereof Fe is used in combination with divided layers of a Cu-group metal (distributed in the matrix) to achieve the effects of suppressing the rotation of magnetic domains.

Thus, in accordance with the present invention, the optimal structure achieves the dual effects of suppressing the movement of magnetic walls in the Fe matrix and suppressing the rotation of magnetic domains by the divided Cu-group metal layers distributed in the Fe matrix.

It is easily seen that the metal structure of the present invention is quite different from that of Jha.

Endo and Manning

Referring now to Endo and Manning, neither of these references disclose any type of layered structure in the context of the present invention. Further, it must be noted that in Endo the only disclosure which occurs is of a permanent magnet of an Fe-Mn alloy, which is entirely different from the composite magnetic material of the present invention.

Endo

Endo discloses a method of producing a semi-hard magnetic material of Fe-Cu alloy. In the Endo method, the temperature of the intermediate annealing and the thickness reduction of the rolling performed before and after intermediate annealing are limited so that the magnetic characteristics, namely any reduction in the rolling magnetic anisotropy, are improved. In Endo, no layered material is used regarding the Fe-Cu based alloy.

In Endo, the intermediate annealing is performed to soften the rolled material and to relieve strain therein, not to perform any dividing of the layers. Further, in Endo, working is performed at a thickness reduction not more than 60% after the intermediate annealing, which is quite different from the heat treatment performed in the present invention for improving magnetization steepness by relieving strains in the matrix which are caused during cold plastic working. Thus, the present invention using a layered material is quite distinct from Endo which does not involve the use of any layered material.

Manning

Manning relates to a permanent magnet which comprises 8 to 18 wt% of an Mn-Fe based alloy where the total content of Fe + Cu is not less than 90 wt%. In distinction, the present invention relates to a magnetic material which is capable of having either a magnetized state or a demagnetized state. Thus, Manning, relating to a permanent magnet, is quite distinct from the present invention.

Conclusion

None of the prior art discloses producing, using a stacked sheet of materials of two different kinds of metals, a magnetic material which is capable of having either a magnetized state or a demagnetized state.

On the issue of motivation, there would be no motivation for one of ordinary skill in the art to combine Jha, which relates to a substrate for an electronic circuit, with a magnetic material such as in Endo, in which magnetic characteristics are important.

Further, even if Jha were to be combined with Endo, one would not reach a multi-layered magnetic structure which has provided divided Cu layers distributed in an Fe matrix which provides an anisotropic structure whereby simultaneously magnetic anisotropy, a predetermined level of coercivity, an improved squareness ratio and magnetization steepness result in the magnetic material obtained.

It is respectfully submitted that the present invention is not rendered obvious over Endo in view of either Jha or Applicants' admissions or further in view of Manning.

Withdrawal of all rejections is requested.

Respectfully submitted,

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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) A method of producing a [semi-hard] magnetic material capable of having either a magnetized state or a demagnetized state, comprising the steps of: preparing a multilayer body in which layers 'A" each containing as the main component thereof Fe having magnetism and layers 'B" each containing a non-magnetic Cu group metal as the main component thereof are stacked on each other; heating the multilayer body so that each of the layers 'B" [are subjected to a] is partially divided by a dividing heat treatment; and applying a cold plastic working to the multilayer body.

2. (Amended) A method of producing the [semi-hard] magnetic material according to claim 1, wherein the dividing heat treatment is performed at a holding temperature of 685 to 1085°C for a holding period [of time] of 10 to 180 minutes.

3. (Amended) A method of producing the [semi-hard] magnetic material according to any one of claims 1 [and] or 2, further comprising the step of performing [an], after the step of said cold plastic working, a steepness-affording heat treatment so that squareness ratio and magnetization steepness are enhanced by heating the multilayer body.

4. (Amended) A method of producing the [semi-hard] magnetic material according to claim 3, wherein the steepness-affording heat treatment for enhancing the squareness ratio and the magnetization steepness by [use of the] heating is performed at a holding temperature of 400 to 700°C for a holding period [of time] of 2 to 120 minutes.

5. (Amended) A method of producing the [semi-hard] magnetic material according to [claim1] claim 1, further comprising the step of performing cold working so that the multilayer body becomes a thin sheet having a thickness of 0.03 to 1.0 mm.

6. (Amended) A [semi-hard] magnetic material capable of having either a magnetized state or a demagnetized state, said magnetic material having a structure in which layers "A" each containing as the main component thereof Fe having magnetism and layers "B" each containing a non-magnetic Cu group metal as the main component thereof are stacked on each other, each of said layers "B" being provided with a shape of a sheet partially divided.

7. (Amended) A magnetic marker having the [semi-hard] magnetic material according to claim 6, said [semi-hard] magnetic material [is] being located so that a bias magnetic field is applied to a magnetostrictive element used for said magnetic marker.

Please add the following new claims:

Claims 8-10 are added as new claims.